

REMARKS

The Office Action of September 2, 2009 has been reviewed and the Examiner's comments carefully considered. Claims 1-4 are pending in this application. New claims 5-9 have been added. These claims have not been added to overcome any prior art rejections. No new matter has been added as support for claims 5-9 may be found in the original application at page 14, line 1 to page 16, line 12.

Claims 1-4 stand rejected under 35 U.S.C. § 103(a) as being obvious over United States Patent No. 4,509,889 to Skogberg et al. or United States Patent No. 4,511,289 to Herron or United States Patent No. 4,636,115 to Davis et al. or the Applicants' admission of prior art in the specification. The Examiner asserts that although these prior art references do not explicitly disclose the thickness, tensile strength, and elongation of the steel as recited in claim 1, it would have been obvious to one skilled in the art to modify these references to use the steel recited in claim 1 since, based on design incentives, such a modification would have yielded a predictable solution set with reasonable expectation of success. Furthermore, the Examiner asserts that discovering the optimum or working ranges involves only routine skill in the art, and the modification would have been obvious to try based on a finite number of identifiable, predictable potential solutions.

Skogberg, Herron, and Davis teach the use of mild steel, with Davis teaching specifically 1016 carbon steel for the production of a steel pipe rockbolt (Skogberg: col. 2, lines 20-24; Herron: col. 1, lines 52-53; Davis: col. 3, lines 25-31). The specification of the present application merely states the tensile strengths and elongations of mild steel of the type taught by the other references that was being used to manufacture steel pipe rockbolts at the time of the invention. The reason that these prior art references do not teach the use of high-strength steel is that it was generally believed by persons skilled in the art at the time of the invention that high-strength steels could not be used for steel pipe rockbolts requiring good workability and high resistance to cracking induced by the strains formed during the pipe-shaping, swaging, and pressure-expanding processes. High-strength steels have high tensile strength and low elongation when compared to mild steel, such as 1016 carbon steel, making them less formable and more prone to cracking. In fact, the cited prior art teaches away from such high-strength,

low elongation materials as it teaches that lower strength, higher elongation materials should be used.

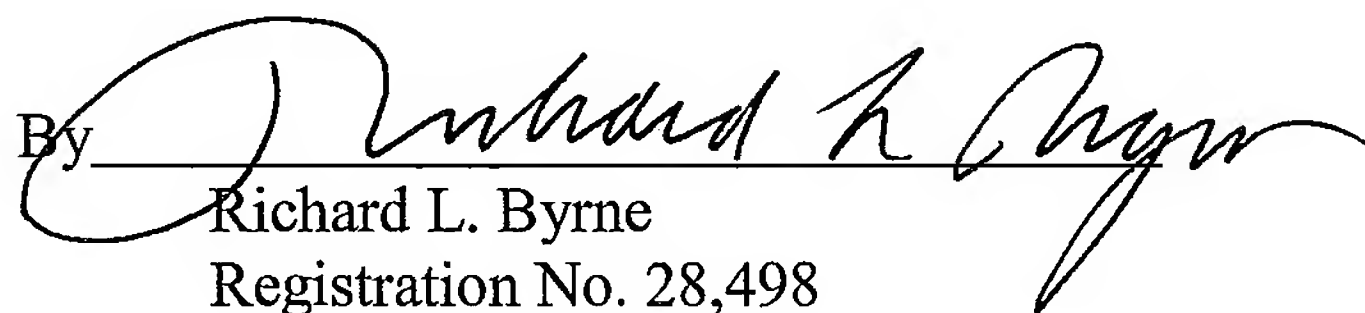
The inventors of the present invention have unexpectedly found that a steel pipe rockbolt may not only be made using high-strength steel as long as it has specific characteristics, but it will have the following advantages: 1) resistance to cracking in the manufacturing process and during the pressure expanding process is increased because strains introduced in the pipe-shaping, swaging, and pressure-expanding processes are reduced by adopting a thin-walled material resulting in improved reliability for the rockbolt; 2) the rockbolt can be expanded at a lower pressure in a shorter time because the moment required to rebend the shaped pipe to its original profile is decreased by adopting a thin-walled material resulting in a reduction in hours to work the rockbolt; and 3) handling of the rockbolt is easier since the weight of the rockbolt is reduced by adopting a thin-walled material.

Each limitation on the steel recited in independent claims 1 and 4 is important in imparting a characteristic necessary to use high-strength steel to make a steel pipe rockbolt. The thickness is important in reducing the strains that accumulate during manufacture of the rockbolt. Minimum elongation is necessary in assuring that the pipe may be expanded without cracking. High enough tensile strength is necessary in assuring that the finished rockbolt will have the proper strength. Further, it is necessary to balance thickness, tensile strength, and elongation in a manner that allows all of these characteristics to be obtained at the same time. While the combination of thickness, tensile strength, and elongation set forth in claim 1 might seem obvious in hindsight, at the time the present invention was made, when only lower tensile strength, higher elongation mild steel was considered suitable for a steel pipe rockbolt, it would not have been obvious to have simultaneously adjusted all three recited parameters. This is especially true considering that the prior art in no way teaches the criticality of the interaction between the parameters necessary to produce an acceptable rockbolt, nor does it suggest which of the many possible choices of steel tensile strength, elongation, and thickness would likely be successful in avoiding cracking during forming and expansion and provide adequate strength to the finished steel pipe rockbolt.

Claims 2, 3, and 5-9, which are dependent on claim 1, contain additional limitations that further define the invention. While claims 2, 3, and 5-9 define over the prior art for the same reasons as claim 1, the additional limitations recited in these claims also define over the cited prior art. None of the cited prior art teaches or suggests the addition of a plating layer, as recited in claims 2 and 5-9, to improve the corrosion resistance, the strength, or any other characteristic of the rockbolt, nor does the cited prior art render obvious the addition of such a plating layer. In addition, claim 3 further limits the tensile strength of the steel recited in claim 1, and thus defines over the prior art for the reasons given above with respect to claim 1. Thus, the Applicants assert that claims 2, 3, and 5-9 are not only patentable for the reasons cited above with respect to claim 1, but because the additional limitations recited in these claims further define over the cited prior art.

For these reasons, Applicants respectfully assert that the claimed invention is not rendered obvious by the cited prior art and respectfully request withdrawal of the rejections and allowance of claims 1-9.

Respectfully submitted,
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